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In re U.S. Application of

Akio AOYAMA

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for: METHOD OF COLLECTING INFORMATION IN MOBILE  
COMMUNICATION SYSTEM

VERIFICATION OF TRANSLATION

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- (1) that he knows well both the Japanese and English languages;
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February 12, 2008

Date

Ryoichi ISHIBASHI

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[Title of the Invention] A method of collecting information, a system for collecting information, and a mobile radio terminal of radio communication

[Claims]

5 [Claim 1]

A method of collecting information used for adjustments with an information collecting server in a radio communication system connected to at least one mobile radio terminal for performing user communications, comprising the steps of:

10                   in said mobile radio terminal,  
                    monitoring a communication status of user communication and detecting as a trigger when said communication status has satisfied a predetermined condition;  
                    acquiring a reception status of a radio signal when said  
15 trigger is detected;  
                    acquiring the position of said mobile radio terminal; and  
                    sending measured information including said reception status and said position to said information collecting server; and  
                    in said information collecting server,  
20                   recording said measured information received from said mobile radio terminal.

[Claim 2]

A method of collecting information used for adjustments with an information collecting server in a radio communication system connected  
25 to at least one mobile radio terminal for performing user communication, comprising the steps of:

in said information collecting server,  
sending trigger information serving as a measuring trigger  
simultaneously to the at least one mobile radio terminal;  
in said mobile radio terminal,  
5 when said trigger information is received, acquiring a  
reception status of a radio signal;  
acquiring the position of said mobile radio terminal; and  
sending measured information including said reception  
status and said position to said information collecting server; and  
10 in said information collecting server,  
recording said measured information received from said  
mobile radio terminal.

[Claim 3]

A method of collecting information used for adjustments with an  
15 information collecting server in a radio communication system connected  
to at least one mobile radio terminal for performing user  
communications, comprising the steps of:

in said information collecting server,  
sending trigger information serving as a measuring trigger  
20 simultaneously to the at least one mobile radio terminal;  
in said mobile radio terminal,  
monitoring a communication status of user communication  
and detecting as a trigger when said communication status has satisfied  
a predetermined condition;  
25 when said trigger information is received or said trigger is  
detected, acquiring a reception status of a radio signal;

acquiring the position of said mobile radio terminal; and  
sending measured information including said reception  
status and said position to said information collecting server; and  
in said information collecting server,  
5 recording said measured information received from said  
mobile radio terminal.

[Claim 4]

A method according to claim 1 or 3, wherein said predetermined  
condition comprises the occurrence of a forced disconnection of the user  
10 communication.

[Claim 5]

A method according to claim 1 or 3, wherein said predetermined condition  
comprises the occurrence of a handover failure.

[Claim 6]

15 A method according to claim 1 or 3, wherein said predetermined condition  
comprises the lowering of a throughput of said user communication below  
a predetermined threshold value.

[Claim 7]

A method according to claim 1 or 3, wherein said predetermined condition  
20 comprises a call which is made.

[Claim 8]

A method according to claim 2 or 3, wherein said information collecting  
server sends said trigger information simultaneously to the at least one  
mobile radio terminal based on a load status on a radio circuit.

25 [Claim 9]

A method according to anyone of claims 1 to 8, further comprising the steps of:

in said information collecting server,  
sending value information indicative of a value to be given  
5 for said measured information which is provided, to said mobile radio terminal when said measured information is received; and  
in said mobile radio terminal,  
displaying the value indicated by said value information  
when said value information is received.

10 [Claim 10]

A method according to anyone of claims 1 to 9, wherein said radio communication system comprises a CDMA radio communication system.

[Claim 11]

A system for collecting information used for adjustments in a radio  
15 communication system for performing user communication, comprising:  
at least one mobile radio terminal for monitoring a  
communication status of user communications, and if a trigger is  
detected when said communication status has satisfied a predetermined  
condition, acquiring a reception status of a radio signal and the position  
20 of the mobile radio terminal, and sending measured information including  
said reception status and said position; and  
an information collecting server for receiving said measured  
information from said mobile radio terminal and recording the measured  
information which has been received.

25 [Claim 12]

A system for collecting information used for adjustments in a radio communication system for performing user communication, comprising:

at least one mobile radio terminal for, if a trigger information as a measuring trigger is received, acquiring a reception status of a radio signal and the position of the mobile radio terminal, and sending  
5 measured information including said reception status and said position;  
and

an information collecting server for sending said trigger information simultaneously to the at least one mobile radio terminal, and  
10 recording the measured information which has been received from said mobile radio terminal.

[Claim 13]

A system for collecting information used for adjustments in a radio communication system for performing user communication, comprising:

15 at least one mobile radio terminal for monitoring a communication status of user communications, and if a trigger is detected when said communication status has satisfied a predetermined condition or trigger information as a measuring trigger is received, acquiring a reception status of a radio signal and the position of the  
20 mobile radio terminal, and sending measured information including said reception status and said position; and

an information collecting server for sending said trigger information simultaneously to the at least one mobile radio terminal, and recording the measured information which has been received from said  
25 mobile radio terminal.

[Claim 14]

A system according to claim 11 or 13, wherein said predetermined condition comprises the occurrence of a forced disconnection of the user communication.

[Claim 15]

5 A system according to claim 11 or 13, wherein said predetermined condition comprises the occurrence of a handover failure.

[Claim 16]

A system according to claim 11 or 13, wherein said predetermined condition comprises the lowering of a throughput of said user

10 communication below a predetermined threshold value.

[Claim 17]

A system according to claim 11 or 13, wherein said predetermined condition comprises a call which is made.

[Claim 18]

15 A system according to claim 12 or 13, wherein said information collecting server sends said trigger information simultaneously to the at least one mobile radio terminal based on a load status on a radio circuit.

[Claim 19]

A system according to anyone of claims 11 to 18, wherein when said

20 measured information is received, said information collecting server sends value information indicative of a value to be given for said measured information which is provided, to said mobile radio terminal, and wherein when said value information is received, said mobile radio terminal displays the value indicated by said value information.

25 [Claim 20]

A system according to anyone of claims 11 to 19, wherein said radio

communication system comprises a CDMA radio communication system.

**[Claim 21]**

A mobile radio terminal for sending information used for adjustments in a radio communication system for performing user communications to an information collecting server, comprising:

a communication status acquisition unit for acquiring a communication status of user communication;

a reception status acquisition unit for acquiring a reception status of a radio signal;

a positional information acquisition unit for acquiring the position of the mobile radio terminal; and

a control unit, triggerable when said communication status acquired by said communication status acquisition unit has satisfied a predetermined condition, for instructing said reception status acquisition unit to acquire said reception status and instructing said positional information acquisition unit to acquire said position, and, when said reception status and said position are acquired, sending measured information including said reception status and said position to said information collecting server.

**[Claim 22]**

A mobile radio terminal for sending information used for adjustments in a radio communication system for performing user communication to an information collecting server, comprising:

a trigger information reception unit for receiving trigger information as a measuring trigger from said information collecting server;

a reception status acquisition unit for acquiring a reception status of a radio signal;

a positional information acquisition unit for acquiring the position of the mobile radio terminal; and

5 a control unit, triggerable when said trigger information is received by said trigger information reception unit, for instructing said reception status acquisition unit to acquire said reception status and instructing said positional information acquisition unit to acquire said position, and, when said reception status and said position are acquired,  
10 sending measured information including said reception status and said position to said information collecting server.

[Claim 23]

A mobile radio terminal for sending information used for adjustments in a radio communication system for performing user communications to an  
15 information collecting server, comprising:

a communication status acquisition unit for acquiring a communication status of user communication;

a trigger information reception unit for receiving trigger information as a measuring trigger from said information collecting  
20 server;

a reception status acquisition unit for acquiring a reception status of a radio signal;

a positional information acquisition unit for acquiring the position of the mobile radio terminal; and

25 a control unit, triggerable when said communication status acquired by said communication status acquisition unit has satisfied a

predetermined condition or said trigger information is received by said trigger information reception unit, for instructing said reception status acquisition unit to acquire said reception status and instructing said positional information acquisition unit to acquire said position, and, when  
5 said reception status and said position are acquired, sending measured information including said reception status and said position to said information collecting server.

[Claim 24]

A mobile radio terminal according to claim 21 or 23, wherein said  
10 predetermined condition comprises the occurrence of a forced disconnection of the user communication.

[Claim 25]

A mobile radio terminal according to claim 21 or 23, wherein said predetermined condition comprises the occurrence of a handover failure.

15 [Claim 26]

A mobile radio terminal according to claim 21 or 23, wherein said predetermined condition comprises the lowering of a throughput of said user communication below a predetermined threshold value.

[Claim 27]

20 A mobile radio terminal according to claim 21 or 23, wherein said predetermined condition comprises a call which is made.

[Claim 28]

A mobile radio terminal according to anyone of claims 21 to 27, wherein when said measured information is received, said information collecting  
25 server sends value information indicative of a value to be given for said measured information which is provided, to said mobile radio terminal,

and wherein when said value information is received, said mobile radio terminal displays the value indicated by said value information.

[Claim 29]

5 A mobile radio terminal according to anyone of claims 21 to 28, wherein said radio communication system comprises a CDMA radio communication system.

[Detailed Description of the Invention]

[0001]

10 [Field of the Invention]

The present invention relates to a radio communication system, and more particularly to the collection of measured values of reception statuses for the maintenance and optimization of a radio communication system.

15 [0002]

[Prior Art]

At present, efforts are being made to lower charges to be paid by subscribers to radio communication systems such as cellular phone systems, PHS, public radio LAN systems, etc. One of the efforts is to lower the operating costs of radio communication systems as much as possible. It is a large task for communication service providers to make less costly adjustments for the maintenance and optimization of radio communication systems.

[0003]

25 The adjustments for the maintenance and optimization of radio communication systems include maintenance and adjustment activities

that are performed to operate the radio communication systems stably without system failures over a long period of time. Items that need to be adjusted include, for example, the transmission power level of a radio base station and the tilt angle of an antenna.

5 [0004]

The maintenance and adjustment of a radio communication system are generally performed based on an evaluation or examination process which employs a radio network design simulator. In order to increase the accuracy of a simulation, information about reception statuses that are measured in service areas (hereinafter referred to as "coverages") of the radio communication system and information about positions where measured values are obtained are input to the design simulator.

[0005]

15 In a CDMA system, for example, items of reception status information include the received signal quality and received signal intensity of a common pilot channel. These items of reception status information are useful items indispensable for system maintenance and adjustments because they serve as indexes for determining whether the services of the radio communication system are available to mobile radio terminals in the measured position or not.

20 [0006]

Heretofore, it has been customary for a dedicated measuring vehicle or a dedicated measuring team to measure reception status information. Fig. 8 of the accompanying drawings is illustrative of a conventional process of collecting reception status information from a

radio communication system. According to the conventional process, as shown in Fig. 8, coverages of the radio communication system in which radio base stations 91, 92, 93 are connected to network 90 are visited by members of measuring teams with reception status measuring vehicles 5 94. At each measuring spot, one reception status measuring vehicle 94 measures reception status information in the corresponding coverage. The measured reception status information is recorded in association with the positional information that is measured by position measuring device 94a on reception status measuring vehicle 94.

10 [0007]

Using the measured reception status information, the communication service provider performs maintenance and adjustments of the radio communication system to operate the radio communication system stably without fail.

15 [0008]

According to another conventional process of collecting reception status information, the general mobile radio terminal owned by a user is used to measure reception status information, and the measured reception status information is collected from the mobile radio terminal 20 (see, for example, Patent Document 1). According to this conventional process, reception status information can quickly and easily be collected without the need for the reception status measuring vehicle shown in Fig. 1.

[0009]

25 [Patent Document 1]

JP-2002-152104-A

[0010]

[Problems to be Solved by the Invention]

The process of measuring reception status information using reception status measuring vehicles 94 shown in Fig. 8 needs a measuring team of members including a vehicle driver, a navigator, and a measuring person for driving each reception status measuring vehicle 94 and making measurements at desired spots. Expenses required to purchase and maintain the measuring vehicles and personnel expenses required to collect reception status information are large and present an obstacle to efforts to lower the operating cost of the radio communication system. The conventional process shown in Fig. 1 takes a lot of time to collect reception status information because all the coverages of the radio communication system need to be visited by a limited number of reception status measuring vehicles.

[0011]

Reception status information in the coverages may be measured by many measuring teams without reception status measuring vehicles 94. However, such a modification requires increased labor costs though reception status measuring vehicles 94 are dispensed with.

[0012]

In a CDMA radio communication system, when users are connected to the system, the load on the radio communication system, i.e., an interference quantity, changes, and hence coverages of the radio communication system vary with time. In order to keep stable coverages while the number of users is being progressively grown to turn the system into a mature one, it is necessary to repeatedly collect reception

status information periodically. Consequently, the CDMA radio communication system requires a much greater cost for collecting reception status information than other systems because reception status measuring vehicles need to travel repeatedly periodically for collecting reception status information.

[0013]

Another problem of the CDMA radio communication system is that while reception status information is being measured by reception status measuring vehicles as they travel through coverages, the user status in the measured areas may change.

[0014]

According to the process of collecting reception status information with the general mobile radio terminals owned by users as disclosed in Patent Document 1, reception status information can be collected at a low cost because no reception status measuring vehicles and no measuring teams of various members are required. Since the coverages of the radio communication system are not visited by reception status measuring vehicles, but reception status information is measured by the mobile radio terminals owned by general users, a large amount of reception status information can be collected in a short period of time.

[0015]

In the CDMA radio communication system, however, the reception status changes for various reasons, and changes in the reception status affect the operation of the radio communication system in various ways. For example, the reception status may change either with time or as the system load changes due to a user access congestion. Changes in the

reception status may cause a change in the frequency of forced communication shutdowns from the network or a change in the frequency of handover failures.

[0016]

5           The process disclosed in Patent Document 1 serves to collect only the relationship between reception status information and positional information, but fails to appropriately recognize causes of changes in the reception status and phenomena brought about by changes in the reception status.

10       [0017]

It is therefore an object of the present invention to provide a method of and a system for, and a mobile radio terminal for, collecting information related to operation of a radio communication system inexpensively and easily.

15       [0018]

[Means to Solve the Problem]

To achieve the above object, a method of the present invention is a method of collecting information used for adjustments with an information collecting server in a radio communication system connected to at least one mobile radio terminal for performing user communications, comprising the steps of:

20           in said mobile radio terminal,  
          monitoring a communication status of user communication and detecting as a trigger when said communication status has satisfied  
25       a predetermined condition;

acquiring a reception status of a radio signal when said trigger is detected;

acquiring the position of said mobile radio terminal; and  
sending measured information including said reception  
5 status and said position to said information collecting server; and  
in said information collecting server,  
recording said measured information received from said  
mobile radio terminal.

[0019]

10 According to the present invention, when a predetermined  
communication status is achieved, the mobile radio terminals acquire  
reception state information and positional information, and send  
measured information including the reception state information and the  
positional information to information collecting server, and the  
15 information collecting server records the information. Therefore, the  
communication service provider of the radio communication system can  
instantaneously obtain many reception statuses in respective positions in  
coverages in relation to the communication status.

[0020]

20 According to the present invention, many items of measured information of  
an area where many users are present are obtained.

[0021]

Another method of the present invention is a method of collecting  
information used for adjustments with an information collecting server in  
25 a radio communication system connected to at least one mobile radio  
terminal for performing user communication, comprising the steps of:

in said information collecting server,  
sending trigger information serving as a measuring trigger  
simultaneously to the at least one mobile radio terminal;  
in said mobile radio terminal,  
5 when said trigger information is received, acquiring a  
reception status of a radio signal;  
acquiring the position of said mobile radio terminal; and  
sending measured information including said reception  
status and said position to said information collecting server; and  
10 in said information collecting server,  
recording said measured information received from said  
mobile radio terminal.

[0022]

According to the present invention, mobile radio terminals are  
15 triggered by trigger information sent from information collecting server  
simultaneously to the mobile radio terminals, to acquire reception status  
information and positional information, and send measured information  
including the reception state information and the positional information to  
the information collecting server. Therefore, many items of measured  
20 information at respective spots at the same time can be obtained.

[0023]

Another method of the present invention is method of collecting  
information used for adjustments with an information collecting server in  
a radio communication system connected to at least one mobile radio  
25 terminal for performing user communications, comprising the steps of:  
in said information collecting server,

5                    sending trigger information serving as a measuring trigger  
simultaneously to the at least one mobile radio terminal;  
                    in said mobile radio terminal,  
                    monitoring a communication status of user communication  
5    and detecting as a trigger when said communication status has satisfied  
a predetermined condition;  
                    when said trigger information is received or said trigger is  
detected, acquiring a reception status of a radio signal;  
                    acquiring the position of said mobile radio terminal; and  
10                   sending measured information including said reception  
status and said position to said information collecting server; and  
                    in said information collecting server,  
                    recording said measured information received from said  
mobile radio terminal.

15    [0024]

According to the present invention, mobile radio terminals are triggered  
by a certain communication status or trigger information sent from  
information collecting server simultaneously to mobile radio terminals, to  
acquire reception status information and positional information, and send  
20    measured information including the reception state information and the  
positional information to the information collecting server. Therefore,  
many items of measured information related to communication statuses  
and the measured information at respective spots at the same time can  
be obtained instantaneously, and maintenance and adjustments of the  
25    radio base stations can be performed instantaneously and effectively  
with reduced man-hours and expenses.

[0025]

According to one aspect of the present invention, said predetermined condition comprises the occurrence of a forced disconnection of the user communication.

[0026]

5 Therefore, measured information which is obtained when user communication is disconnected is collected.

[0027]

According to one aspect of the present invention, said predetermined condition comprises the occurrence of a handover failure.

10 [0028]

Therefore, measured information which is obtained when handover failure is occurred is collected.

[0029]

15 According to one aspect of the present invention, said predetermined condition comprises the lowering of a throughput of said user communication below a predetermined threshold value.

[0030]

Therefore, measured information which is obtained when a throughput is lowered the predetermined threshold is collected.

20 [0031]

According to one aspect of the present invention, said predetermined condition comprises a call which is made.

[0032]

Measured information which is obtained when a call is made is collected.

25 Therefore, important area that many users gather can be known.

[0033]

According to one aspect of the present invention, said information collecting server sends said trigger information simultaneously to the at least one mobile radio terminal based on a load status on a radio circuit.  
[0034]

5 Measured information of some areas can be obtained simultaneously at the timing decided based on a load status on a radio circuit. Therefore, change of reception status according to change of load status can be known.

[0035]

10 According to one aspect of the present invention, the method further comprising the steps of:

in said information collecting server,

sending value information indicative of a value to be given for said measured information which is provided, to said mobile radio terminal when said measured information is received; and

15 in said mobile radio terminal,

displaying the value indicated by said value information when said value information is received.

[0036]

20 The communication service provider can obtain measured information from user's mobile radio terminals in exchange for inexpensive valuable points. Therefore, the communication service provider can obtain many items of measured information related to communication status by giving inexpensive valuable pints to users instantaneously.

25 [0037]

According to one aspect of the present invention, said radio

communication system comprises a CDMA radio communication system.

[0038]

A system for collecting information of the present invention, used for adjustments in a radio communication system for performing user communication, comprising:

at least one mobile radio terminal for monitoring a communication status of user communications, and if a trigger is detected when said communication status has satisfied a predetermined condition, acquiring a reception status of a radio signal and the position of the mobile radio terminal, and sending measured information including said reception status and said position; and

an information collecting server for receiving said measured information from said mobile radio terminal and recording the measured information which has been received.

[0039]

Another system for collecting information of present invention, used for adjustments in a radio communication system for performing user communication, comprising:

at least one mobile radio terminal for, if a trigger information as a measuring trigger is received, acquiring a reception status of a radio signal and the position of the mobile radio terminal, and sending measured information including said reception status and said position; and

an information collecting server for sending said trigger information simultaneously to the at least one mobile radio terminal, and

recording the measured information which has been received from said mobile radio terminal.

[0040]

5 A system for collecting information of the present invention, used for adjustments in a radio communication system for performing user communication, comprising:

at least one mobile radio terminal for monitoring a communication status of user communications, and if a trigger is detected when said communication status has satisfied a predetermined condition or trigger information as a measuring trigger is received,  
10 acquiring a reception status of a radio signal and the position of the mobile radio terminal, and sending measured information including said reception status and said position; and

an information collecting server for sending said trigger  
15 information simultaneously to the at least one mobile radio terminal, and recording the measured information which has been received from said mobile radio terminal.

[0041]

A mobile radio terminal of the present invention, for sending information  
20 used for adjustments in a radio communication system for performing user communications to an information collecting server, comprising:

a communication status acquisition unit for acquiring a communication status of user communication;

a reception status acquisition unit for acquiring a reception  
25 status of a radio signal;

a positional information acquisition unit for acquiring the position of the mobile radio terminal; and

a control unit, triggerable when said communication status acquired by said communication status acquisition unit has satisfied a predetermined condition, for instructing said reception status acquisition unit to acquire said reception status and instructing said positional information acquisition unit to acquire said position, and, when said reception status and said position are acquired, sending measured information including said reception status and said position to said information collecting server.

[0042]

Another mobile radio terminal of the present invention, for sending information used for adjustments in a radio communication system for performing user communication to an information collecting server, comprising:

a trigger information reception unit for receiving trigger information as a measuring trigger from said information collecting server;

a reception status acquisition unit for acquiring a reception status of a radio signal;

a positional information acquisition unit for acquiring the position of the mobile radio terminal; and

a control unit, triggerable when said trigger information is received by said trigger information reception unit, for instructing said reception status acquisition unit to acquire said reception status and instructing said positional information acquisition unit to acquire said

position, and, when said reception status and said position are acquired, sending measured information including said reception status and said position to said information collecting server.

[0043]

- 5 Another mobile radio terminal of the present invention, for sending information used for adjustments in a radio communication system for performing user communications to an information collecting server, comprising:

- 10 a communication status acquisition unit for acquiring a communication status of user communication;
- a trigger information reception unit for receiving trigger information as a measuring trigger from said information collecting server;
- 15 a reception status acquisition unit for acquiring a reception status of a radio signal;
- a positional information acquisition unit for acquiring the position of the mobile radio terminal; and
- a control unit, triggerable when said communication status acquired by said communication status acquisition unit has satisfied a
- 20 predetermined condition or said trigger information is received by said trigger information reception unit, for instructing said reception status acquisition unit to acquire said reception status and instructing said positional information acquisition unit to acquire said position, and, when said reception status and said position are acquired, sending measured
- 25 information including said reception status and said position to said information collecting server.

[0044]

[Preferred Embodiments of the Invention]

Embodiment according to the present invention will be described with reference to the drawings.

5 [0045]

Fig. 1 schematically shows a radio communication system according to an embodiment of the present invention. As shown in Fig. 2, the radio communication system has radio base stations 11, 12, 13, network 2, and information collecting server 1. Mobile radio terminals 21, 22 can be connected to the radio communication system. In Fig. 2, only two mobile radio terminals are shown though many mobile radio terminals can actually be connected to the radio communication system. Actually, the radio communication system has many radio base stations, but only three radio base stations are shown in Fig. 2 for illustrative purposes.

15 [0046]

Mobile radio terminals 21, 22 comprise mobile terminals of cellular phone systems, PHS, public radio LAN systems, etc. that users use in the radio communication system. The users who use mobile radio terminals 21, 22 are users who have consented to provide information about their own positions and the reception status of radio signals from radio base stations for stable operation of the radio communication system.

[0047]

25 Fig. 2 shows in block form details of mobile radio terminal 21 according to the present embodiment. Since mobile radio terminals 21,

22 shown in Fig. 1 are identical in arrangement, only mobile radio terminal 21 is shown in Fig. 2.

[0048]

As shown in Fig. 2, mobile radio terminal 21 comprises positional  
5 information acquisition unit 31, reception status acquisition unit 32,  
communication status acquisition unit 33, time information acquisition  
unit 34, control unit 35, and display unit 36.

[0049]

Positional information acquisition unit 31 acquires information  
10 representative of the position of mobile radio terminal 21. Positional  
information acquisition unit 31 measures its own position using a GPS  
(Global Positioning System), for example, and acquires the measured  
position as the positional information.

[0050]

15 Reception status acquisition unit 32 acquires information  
representative of the reception status of a radio signal from a radio base  
station. The information representative of the reception status, i.e., the  
reception status information, is useful for the maintenance and  
adjustments of the radio communication system. Examples of the  
20 reception status information are  $E_c/I_o$  (received signal power vs.  
interference power ratio per chip) indicative of a received signal quality  
of a common pilot channel in a CDMA radio communication system, and  
a received signal intensity in such a common pilot channel.

[0051]

25 Communication status acquisition unit 33 can acquire information  
representative of the communication status of user communications.

The information representative of the communication status, i.e., the communication status information, is information indicative of the status of communications that are performed using a radio signal. Examples of the communication status information are information indicating that the mobile radio terminal is unable to receive a radio signal from a radio base station and user communications are forcibly shut off, and information indicating that the mobile radio terminal is unable to make an outgoing call to another mobile radio terminal. Other examples of the communication status information are information indicating a handover failure and information indicating a communication throughput.

[0052]

Time information acquisition unit 34 can acquire information representative of the time when reception status information is acquired, time information representative of the time when a reception status has started to be measured, and time information representative of the period of time for which a reception status has been measured.

[0053]

When positional information, time information, and reception status information are acquired, control unit 35 sends the acquired information as measured information through either one of the radio base stations and network 2 to information collecting server 1. The measured information is information that includes positional information, time information, and reception status information.

[0054]

When communication status information acquired by communication status acquisition unit 33 satisfies a predetermined

condition, control unit 35 is triggered to instruct reception status acquisition unit 32 to acquire reception status information, instruct positional information acquisition unit 31 to acquire positional information, and instruct time information acquisition unit 34 to acquire a measuring start time and a measuring period of time. For example, when user communication such as a call or data communication are forcibly shut off, mobile radio terminal 21 is triggered to acquire reception status information. Alternatively, mobile radio terminal 21 may be triggered to acquire reception status information when the communication throughput becomes lower than a predetermined threshold value, or when a call is made to start user communications. [0055]

When control unit 35 receives information representative of a valuable point from information collecting server 1, control unit 35 displays the valuable point on display unit 36. [0056]

The valuable point is a point having a value corresponding to money, and is given to a user in return for the measured information provided by the user. An example of the valuable point is a point that can be used in electronic commerce on the Internet that is included in network 2. Another example of the valuable point is any of various cybercash and electronic money. Still another example of the valuable point is a point having a value in a core network of the radio communication system which is included in network 2, i.e., a point that can be used to offset a charge to be paid for using the radio communication system. [0057]

Display unit 36 displays valuable point information according to an instruction from control unit 35.

[0058]

Radio base stations 11, 12, 13 are facilities for sending radio  
5 signals to and receiving radio signals from mobile radio terminals 21, 22,  
and comprise base stations in cellular phone systems or PHSs, or  
access points of radio LAN systems or the like.

[0059]

Network 2 comprises a core network of the radio communication  
10 system according to the present embodiment, e.g., a network made up of  
mobile exchanges of a cellular phone system. In the present  
embodiment, network 2 also includes the Internet connected through a  
gateway (not shown).

[0060]

15 Information collecting server 1 comprises a computer such as a  
workstation or the like. Information collecting server 1 receives and  
records measured information transmitted from mobile radio terminals  
21, 22. When information collecting server 1 receives and records  
measured information transmitted from mobile radio terminals 21, 22,  
20 information collecting server 1 sends valuable point information that is to  
be given to the users of mobile radio terminals 21, 22, i.e., transmission  
sources, through network 2 and a radio base station to mobile radio  
terminals 21, 22.

[0061]

25 Fig. 3 shows an operation sequence of the radio communication  
system and the mobile radio terminal according to the present

embodiment for collecting reception status information. In Fig. 4, operation of only mobile radio terminal 21 and information collecting server 1 is illustrated.

[0062]

5           Dedicated software is installed beforehand in the mobile radio terminal of a user who has consented to provide measured information including information about reception status information and positional information in return for the acquisition of a valuable point. The mobile radio terminal with the dedicated software installed is used as mobile  
10 radio terminals 21, 22. With the dedicated software installed, mobile radio terminals 21, 22 can automatically operate as follows:

[0063]

As shown in Fig. 3, mobile radio terminal 21 monitors the communication status of user communications, and detects as a trigger  
15 when communication status information has satisfied a predetermined condition (step 101). When mobile radio terminal 21 detects the trigger, mobile radio terminal 21 measures a reception status and acquires reception status information indicative of the measured reception status (step 102). At this time, mobile radio terminal 21 also acquires time  
20 information. Instead of the operation in steps 101, 102, mobile radio terminal 21 may continuously measure a reception status at all times and, when mobile radio terminal 21 detects a trigger, it may use the reception status measured at the time for a subsequent process.

[0064]

25           Then, mobile radio terminal 21 measures its own position using a GPS, and acquires positional information indicative of the measured

position (step 103). However, mobile radio terminal 21 may not be able to acquire positional information depending on its position or environment. In that case, mobile radio terminal 21 may use positional information which it has acquired at a past time closest to the present time. Moreover, mobile radio terminal 21 should preferably add information indicative of low reliability to the positional information. Then, mobile radio terminal 21 sends measured information including the positional information, the time information, and the reception status information to information collecting server 1 (step 104).

[0065]

In order to reflect the measured information early for system adjustments, mobile radio terminal 21 should preferably send the measured information including the reception status information and the positional information to information collecting server 1 immediately after mobile radio terminal 21 has acquired the reception status information and the positional information. If a forced shutdown of user communication or a handover failure is used as a trigger, then mobile radio terminal 21 is unable to send the measured information to information collecting server 1 immediately after the trigger is detected.

In this case, mobile radio terminal 21 may send the measured information after the circuit becomes available again.

[0066]

Information collecting server 1 receives the measured information from mobile radio terminal 21, and records the received information in its own memory (step 105). Actually, since information collecting server 1 receives measured information similarly from a plurality of mobile radio

terminals, information collecting server 1 collects reception status information in various positions in coverages.

[0067]

The measured information collected by information collecting server 1 is related to various operations of the radio communication system depending on trigger conditions. Consequently, not only a map representing an association between positions and reception statuses, but also maps related to various statuses are obtained. For example, a map of information that is acquired when user communications are forcibly disconnected is useful for estimating an area where a radio-wave arrival status is poor. A map of information that is acquired when a handover failure occurs is useful for estimating a position where there is a coverage interruption between radio base stations. A map of information that is acquired when a throughput is lower than a predetermined threshold value is useful for estimating a position where a communication quality is poor. A map of information that is acquired when a call is made is useful for estimating a position where many users are present.

[0068]

The measuring time represented by the time information contained in the measured information is useful to estimate a time-dependent change in the communication status or the reception status.

[0069]

Then, information collecting server 1 gives a valuable point to the user of mobile radio terminal 21, and sends valuable point information representative of a value (valuable point) given in return for the

information provided by the user, to mobile radio terminal 21 (step 106).

For non-delay system operation, information collecting server 1 should preferably send valuable point information is sent to mobile radio terminal 21 immediately after the measured information from mobile

5 radio terminal 21. If a traffic buildup is to be prevented, however, information collecting server 1 may delay the timing to send valuable point information. For example, information collecting server 1 may collect several items of valuable point information and thereafter send the collected items of valuable point information. Information collecting  
10 server 1 may also send collected items of valuable point information late at night.

[0070]

Actually, a valuable point may be given by different processes depending on the form of the variable point. For example, if a valuable  
15 point can be used to offset a charge to be paid for using the radio communication system, then it may be recorded and managed in information collecting server 1, a billing center (not shown), or a dedicated valuable point managing server. If a valuable point is in the form of electric money related to a bank account, then the valuable point  
20 may be sent to a bank server.

[0071]

When measure information is thus collected by information collecting server 1, core network 2 of the radio communication system uses the collected information for the maintenance of radio base stations  
25 11, 12, 13 and for adjusting various parameters including the transmission output power and the tilt angles of antennas.

[0072]

According to the present embodiment, as described above, when a predetermined communication status is achieved, the mobile radio terminals of users acquire reception state information and positional information, and send measured information including the reception state information and the positional information to information collecting server 1. Therefore, the communication service provider can instantaneously obtain many items of measured information related to the communication status by giving inexpensive valuable points to users, and can instantaneously and effectively perform maintenance and adjustments of the radio base stations with reduced man-hours and expenses.

[0073]

According to the present embodiment, furthermore, since many items of measured information can instantaneously be collected and reflected for system maintenance and adjustments, the measured information can provide outstanding advantages while the number of users is being progressively grown in a radio communication system, e.g., a CDMA radio communication system, where coverages change due to a load status or an interference quantity on radio circuits when mobile radio terminals are connected.

[0074]

Moreover, instantaneous and accurate system adjustments are significant in an area where many users are present. Since many items of measured information of such an area are obtained, it is possible to make instantaneous and accurate system adjustments using many items of measured information in an area where the need for system adjustments is high.

[0075]

According to the present embodiment, measured information is acquired only from the mobile radio terminals of users who have consented to provide positional information and reception status information. Therefore no information is automatically acquired from users who do not want to send positional information and reception status information to the communication service provider. The users are thus free from undue concerns from the standpoint of their privacy and electric power consumption by their mobile radio terminals.

[0076]

Another embodiment of the present invention will be described below.

[0077]

A radio communication system according to the present embodiment is identical in arrangement to the radio communication system shown in Fig. 1. However, the radio communication system according to the present embodiment operates differently from the operation sequence shown in Fig. 3 in that a trigger for mobile radio terminals 21, 22 to obtain measured information is given from information collecting server 1 simultaneously to a plurality of mobile radio terminals.

[0078]

Fig. 4 shows in block form a mobile radio terminal according to another embodiment of the present invention. The mobile radio terminal shown in Fig. 4 differs from the mobile radio terminal shown in Fig. 2 in that it has trigger information reception unit 37 instead of communication status acquisition unit 33.

[0079]

Trigger information reception unit 37 receives trigger information from information collecting server 1, and sends the received trigger information to control unit 35. The trigger information is information for triggering the measurement of information. According to the present  
5 embodiment, information collecting server 1 can send trigger information simultaneously to a plurality of mobile radio terminals in order to cause the mobile radio terminals to start measuring information.

[0080]

Control unit 35 is triggered by the reception of trigger information  
10 from information collecting server 1 to instruct reception status acquisition unit 32 to measure a reception status, instruct positional information acquisition unit 31 to measure positional information, and instruct time information acquisition unit 34 to acquire a measuring time, etc.

15 [0081]

Fig. 5 shows an operation sequence of the radio communication system and the mobile radio terminal according to the present embodiment for collecting reception status information. In Fig. 5, operation of only mobile radio terminal 21 and information collecting  
20 server 1 is illustrated.

[0082]

Dedicated software is installed beforehand in the mobile radio terminal of a user who has consented to provide measured information including reception status information and positional information in return  
25 for the acquisition of a valuable point. The mobile radio terminal with the dedicated software installed is used as mobile radio terminals 21, 22.

[0083]

As shown in Fig. 5, information collecting server 1 sends trigger information simultaneously to a plurality of mobile radio terminals (step 201). For example, information collecting server 1 sends trigger information in a special time zone where a reception status is to be observed, such as a time zone in which the system load is statistically high or a time zone in which the system load is statistically low. In response to the trigger information, mobile radio terminal 21 measures a reception status and acquires the measured reception status as reception status information (step 202). At this time, mobile radio terminal 21 also acquires time information.

[0084]

The subsequent processing in steps 203 through 207 is the same as the processing in steps 103 through 107 shown in Fig. 3.

[0085]

The measured information collected by information collecting server 1 has been simultaneously acquired by a plurality of mobile radio terminals which have been triggered by the reception of the trigger information. Therefore, not only a map representing an association between positions and reception statuses, but also reception statuses in various positions in coverages at the same time are acquired. The information thus acquired is useful to estimate how changes in the reception statuses in the respective positions are related.

[0086]

According to the present embodiment, as described above, mobile radio terminals are triggered by trigger information sent from information collecting server 1 simultaneously to a plurality of mobile radio terminals,

to acquire reception status information and positional information, and send measured information including the reception state information and the positional information to information collecting server 1. Therefore, the communication service provider can instantaneously obtain many items of measured information at respective spots at the same time by giving inexpensive valuable points to users, and can instantaneously and effectively perform maintenance and adjustments of the radio base stations with reduced man-hours and expenses.

[0087]

Another embodiment of the present invention will be described below.

[0088]

A radio communication system according to the present embodiment is identical in arrangement to the radio communication system shown in Fig. 1. However, the radio communication system according to the present embodiment operates differently from the operation sequence shown in Fig. 3 in that triggers for mobile radio terminals 21, 22 to obtain measured information include a trigger given from information collecting server 1 simultaneously to a plurality of mobile radio terminals, as shown in Fig. 3, and a trigger which is detected by the mobile radio terminals themselves as shown in Fig. 3.

[0089]

Fig. 6 shows in block form a mobile radio terminal according to this embodiment of the present invention. The mobile radio terminal shown in Fig. 6 differs from the mobile radio terminal shown in Fig. 2 in that it has both communication status acquisition unit 33 and trigger

information reception unit 37. Communication status acquisition unit 33 shown in Fig. 6 is identical to communication status acquisition unit 33 shown in Fig. 2, and trigger information reception unit 37 shown in Fig. 6 is identical to trigger information reception unit 37 shown in Fig. 4.

5 [0090]

When communication status information is acquired as a trigger by communication status acquisition unit 33 or when trigger information is received by trigger information reception unit 37, control unit 35 is triggered to instruct reception status acquisition unit 32, communication status acquisition unit 33, and time information acquisition unit 34.

10

[0091]

Fig. 7 shows an operation sequence of the radio communication system and the mobile radio terminal according to the present embodiment for collecting reception status information. In Fig. 7, operation of only mobile radio terminal 21 and information collecting server 1 is illustrated.

15

[0092]

Dedicated software is installed beforehand in the mobile radio terminal of a user who has consented to provide measured information including reception status information and positional information in return for the acquisition of a valuable point. The mobile radio terminal with the dedicated software installed is used as mobile radio terminals 21, 22.

20

[0093]

As shown in Fig. 7, information collecting server 1 sends trigger information simultaneously to a plurality of mobile radio terminals (step 301), or mobile radio terminal 21 detects as a trigger when

25

communication status information has satisfied a predetermined condition (step 302).

[0094]

5        When either trigger is generated, mobile radio terminal 21 measures a reception status and acquires it as reception status information (step 303). At this time, mobile radio terminal 21 also acquires time information.

[0095]

10       The subsequent processing in steps 304 through 308 is the same as the processing in steps 103 through 107 shown in Fig. 3.

[0096]

15       The measured information collected by information collecting server 1 is related to various operations of the radio communication system or obtained at the same time, depending on trigger conditions. Consequently, not only a map representing an association between positions and reception statuses, but also maps related to various statuses or maps representative of reception statuses in various positions in coverages at the same time are acquired.

[0097]

20       According to the present embodiment, as described above, mobile radio terminals are triggered by a certain communication status or trigger information sent from information collecting server 1 simultaneously to a plurality of mobile radio terminals, to acquire reception status information and positional information, and send measured information including the  
25       reception state information and the positional information to information collecting server 1. Therefore, the communication service provider can

instantaneously obtain many items of measured information related to communication statuses and measured information at respective spots at the same time by giving inexpensive valuable points to users, and can instantaneously and effectively perform maintenance and adjustments of the radio base stations with reduced man-hours and expenses.

[0098]

[Effect of the Invention]

According to the present invention, when a predetermined communication status is achieved, the mobile radio terminals acquire reception state information and positional information, and send measured information including the reception state information and the positional information to information collecting server, and the information collecting server records the information. Therefore, the communication service provider of the radio communication system can instantaneously obtain many reception statuses in respective positions in coverages in relation to the communication status, and maintenance and adjustments of the radio base stations can be performed instantaneously and effectively with reduced man-hours and expenses.

[0099]

Many items of measured information related to areas that many users gather are obtained, and instantaneous and accurate adjustments are important in these areas. Therefore, instantaneous and accurate adjustments by using of many items of measured information can be applied in the areas which requirement is high.

[0100]

Mobile radio terminals are triggered by trigger information sent

from information collecting server simultaneously to the mobile radio terminals, to acquire reception status information and positional information, and send measured information including the reception state information and the positional information to the information collecting server. Therefore, many items of measured information at respective spots at the same time can be obtained and can instantaneously and effectively perform maintenance and adjustments of the radio base stations with reduced man-hours and expenses.

[0101]

10 Measured information which is obtained when user communication is disconnected is collected. Therefore, areas where radio-wave arrival status is poor and where adjustment for remediation is required can be known.

[0102]

15 Measured information which is obtained when handover failure is occurred is collected. Therefore, areas where there is a coverage interruption between radio base stations and where adjustment for remediation is required can be known.

[0103]

20 Measured information which is obtained when a throughput is lowered the predetermined threshold is collected. Therefore, areas where quality of communication is low and where adjustment for remediation is required can be known.

[0104]

25 Measured information which is obtained when a call is made is collected. Therefore, important area that many users gather can be known.

[0105]

Measured information of some areas can be obtained simultaneously at the timing decided based on a load status on a radio circuit. Therefore, change of reception status according to change of load status can be known.

[0106]

The communication service provider can obtain measured information from user's mobile radio terminals in exchange for inexpensive valuable points. Therefore, the communication service provider can obtain many items of measured information related to communication status by giving inexpensive valuable pints to users instantaneously, and maintenance and adjustments of the radio base stations can be performed instantaneously and effectively with reduced man-hours and expenses.

[0107]

In a CDMA radio communication system, coverage is changed according to the status of the load on the radio communication system, i.e., an interference quantity. However, in this invention, many items of measured information are gathered instantaneously, and those items can be reflected to maintenance and adjustment. Therefore, maintenance and adjustment for radio facilities can be performed in quick response to the change during the increase of users.

[Brief Description of the Drawings]

[Fig. 1]

A block diagram of a CPU system according to an embodiment of the present invention.

[Fig. 1]

A schematic view of a radio communication system according to an embodiment of the present invention;

5 [Fig. 2]

A block diagram of a mobile radio terminal according to the embodiment of the present invention;

[Fig. 3]

10 A flowchart of an operation sequence of the radio communication system and the mobile radio terminal according to the embodiment of the present invention for collecting reception status information;

[Fig. 4]

A block diagram of a mobile radio terminal according to another embodiment of the present invention;

15 [Fig. 5]

A flowchart of an operation sequence of the radio communication system and the mobile radio terminal according to the other embodiment of the present invention for collecting reception status information;

[Fig. 6]

20 A block diagram of a mobile radio terminal according to still another embodiment of the present invention; and

[Fig. 7]

25 A flowchart of an operation sequence of the radio communication system and the mobile radio terminal according to the still other embodiment of the present invention for collecting reception status information.

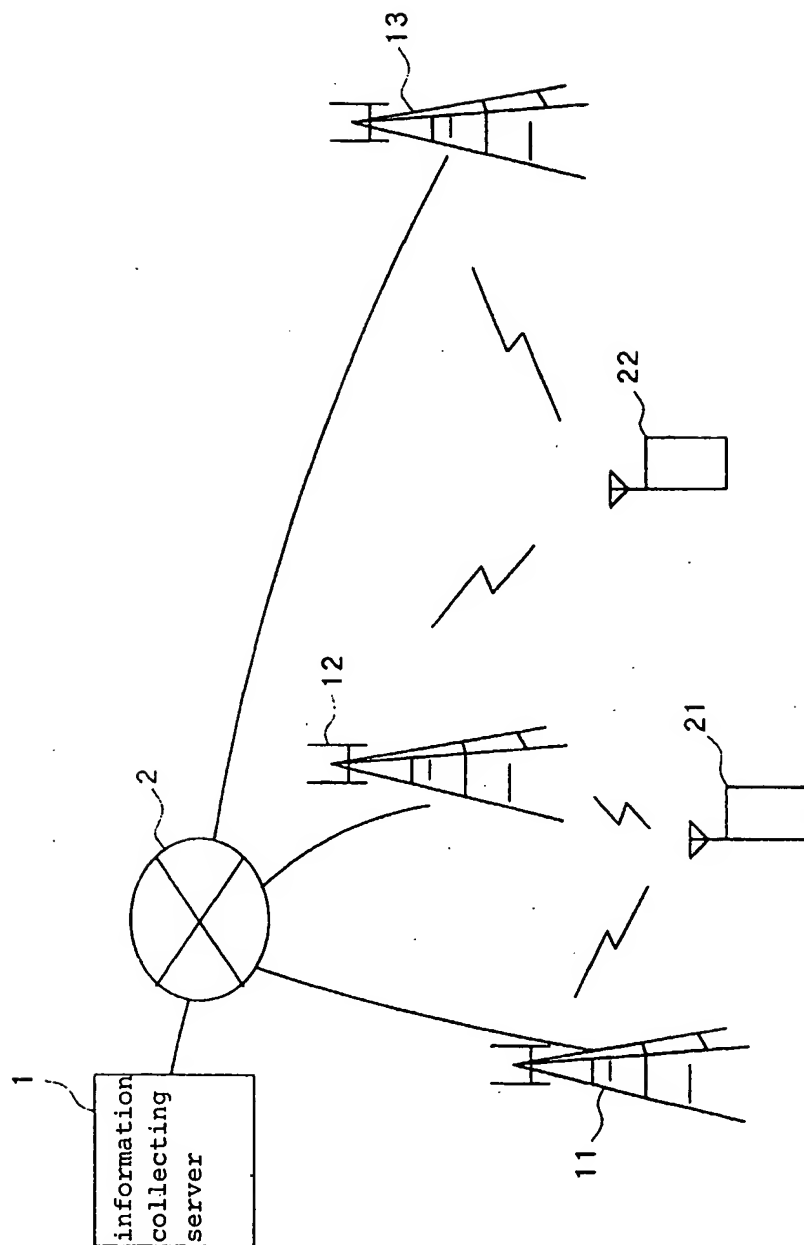
[Fig. 8]

A schematic view illustrative of a conventional process of collecting reception status information from a radio communication system;

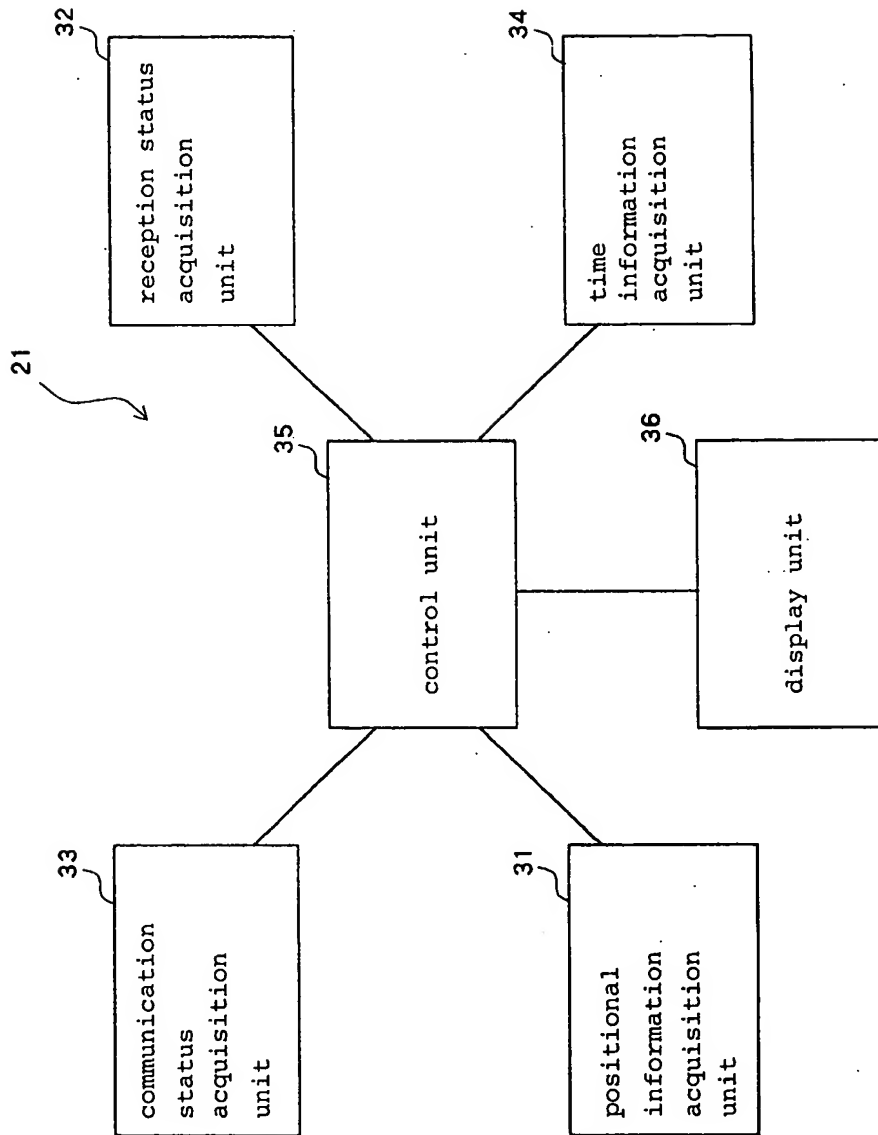
[Explanation of Symbols]

- 1 information collecting server
- 5 2 network
- 11, 12, 13 radio base station
- 21, 22 mobile radio terminal
- 31 positional information acquisition unit
- 32 reception status acquisition unit
- 10 33 communication status acquisition unit
- 34 time information acquisition unit
- 35 control unit
- 36 display unit
- 37 trigger information reception unit
- 15 101-107, 201-207, 301-308 step

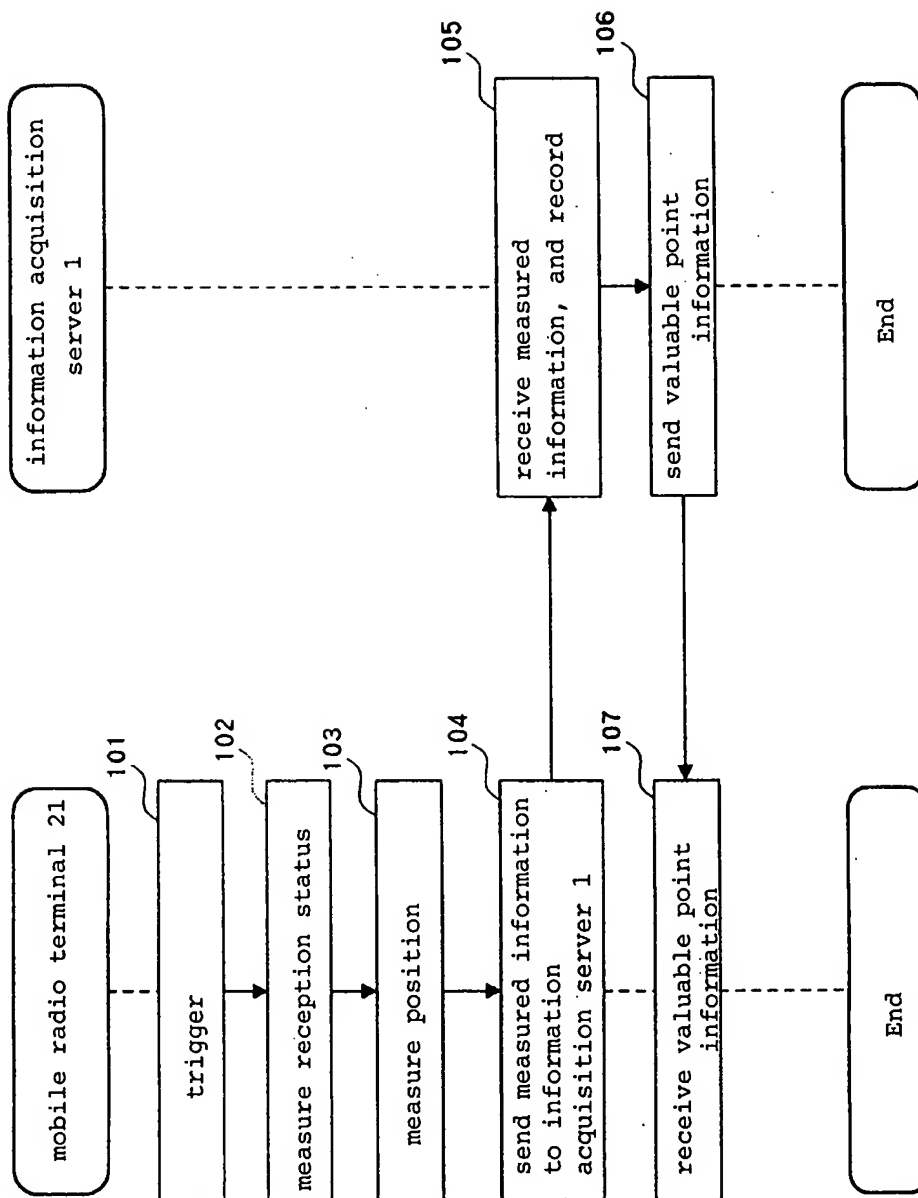
[ Fig. 1 ]



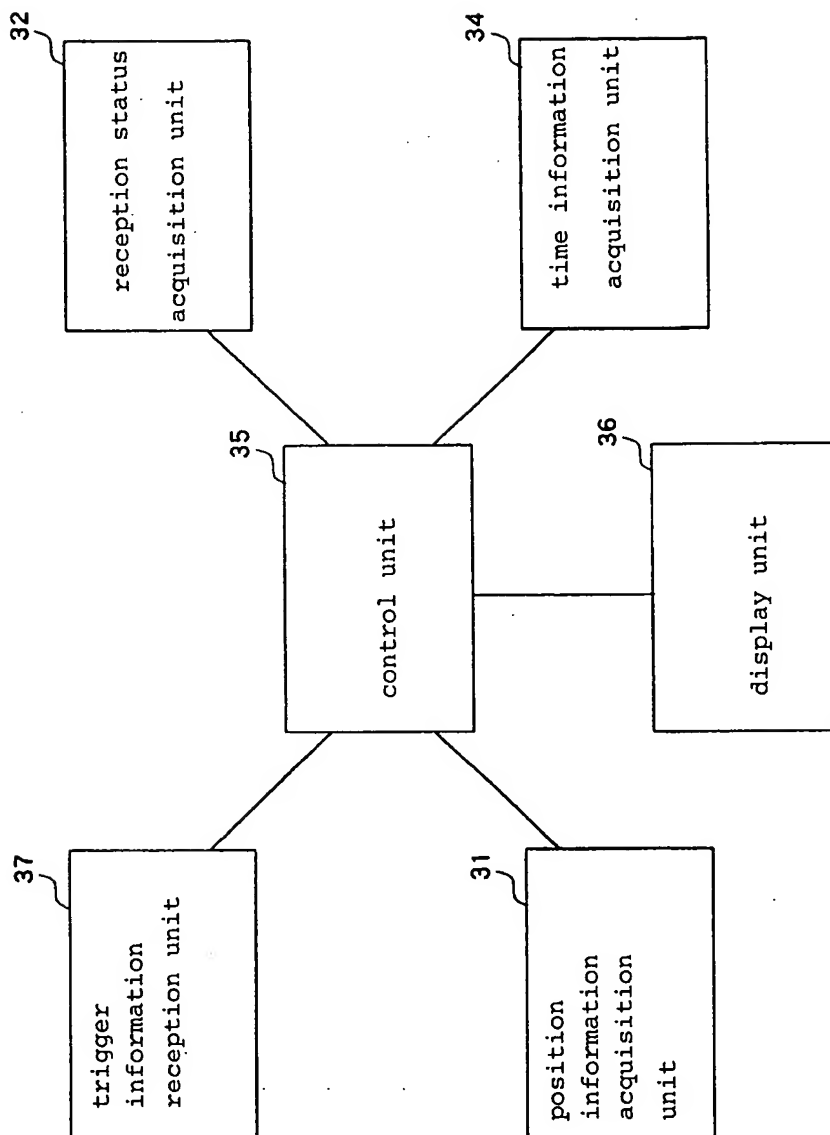
[ Fig. 2 ]



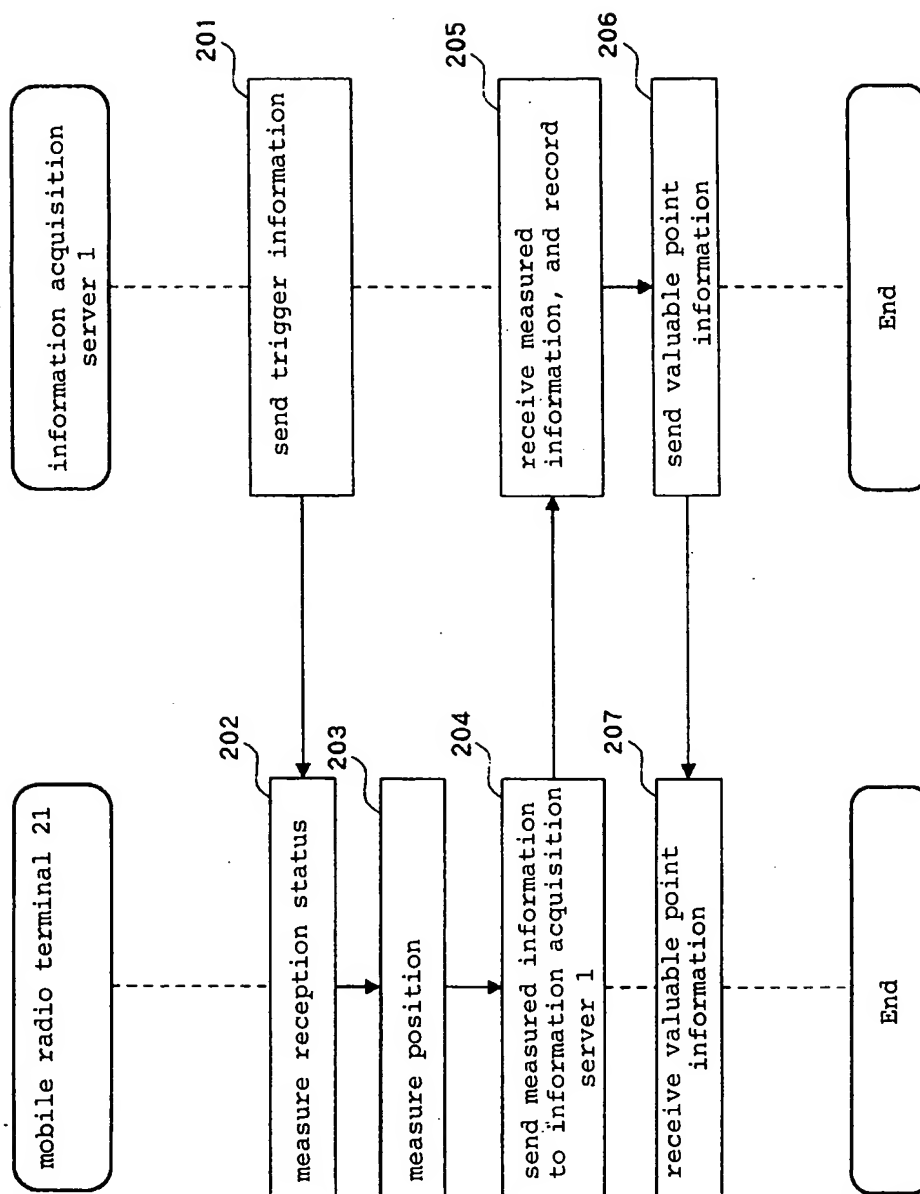
[ Fig. 3 ]



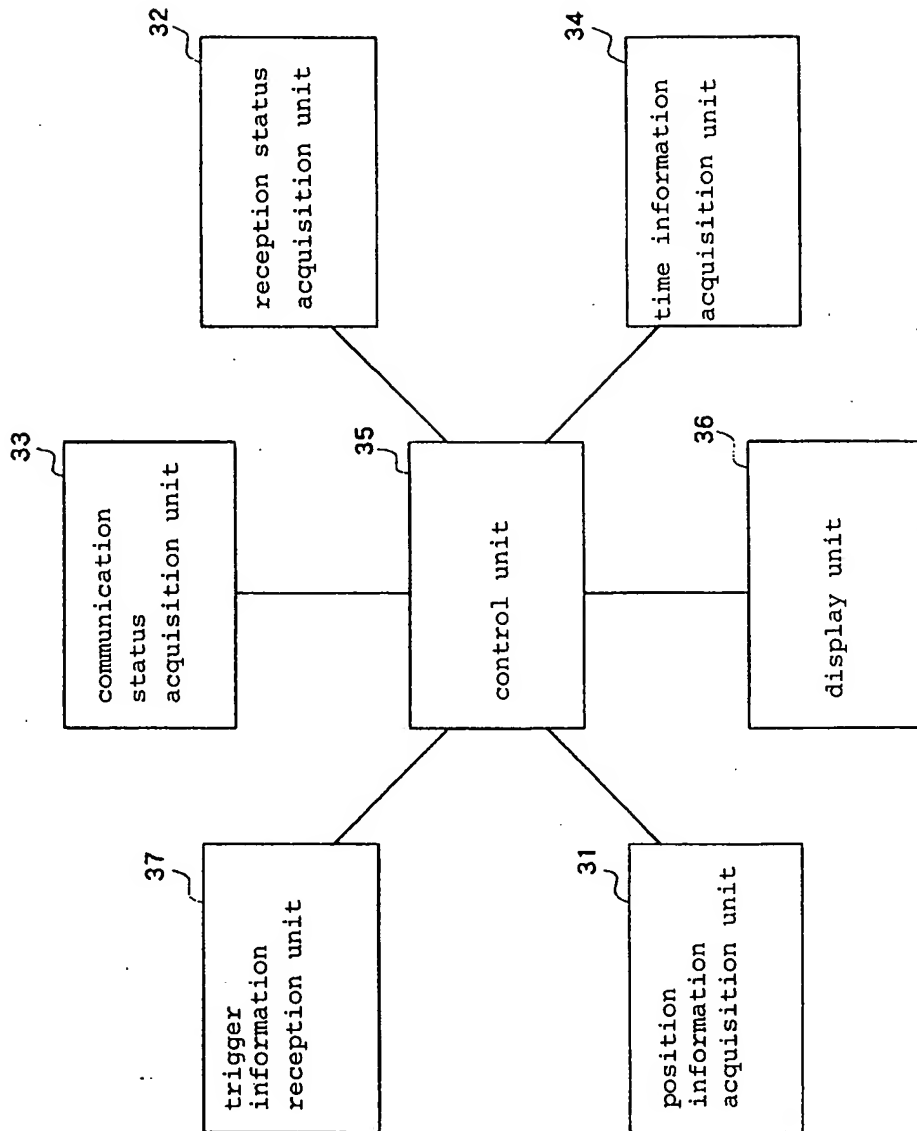
[ Fig. 4 ]



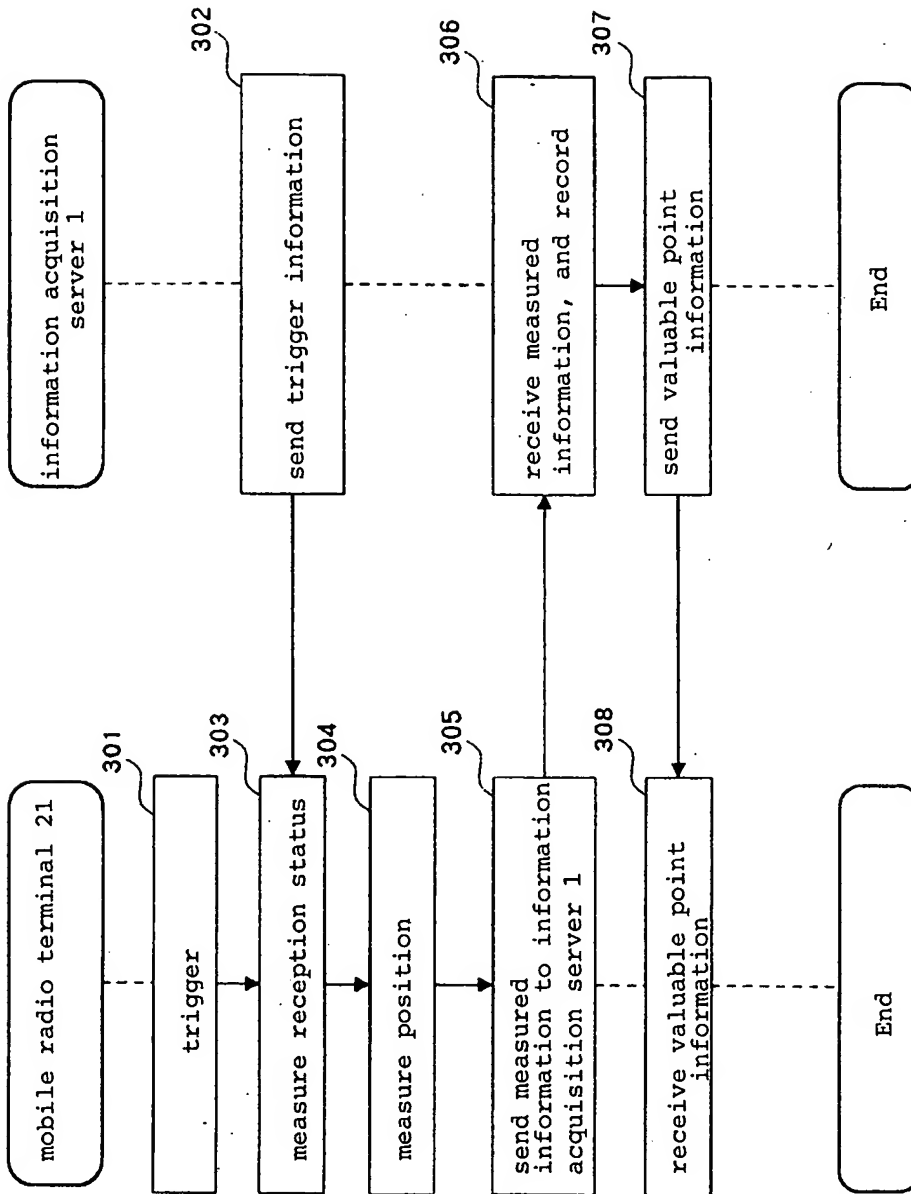
[ Fig.5 ]



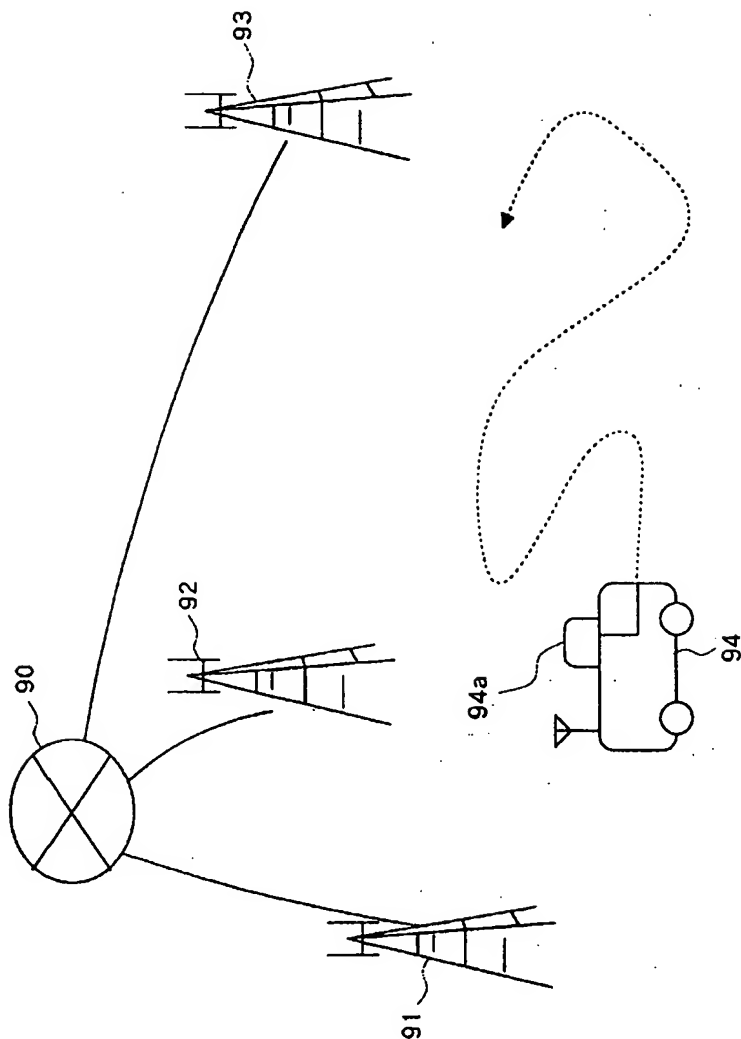
[ Fig. 6 ]



[ Fig. 7 ]



[ Fig. 8 ]



[Document Name] Abstract

[Abstract]

[problems] The present invention provides a method of and a system for, and a mobile radio terminal for, collecting information related to operation  
5 of a radio communication system inexpensively and easily.

[Solution] Mobile radio terminals 21, 22 monitor a communication status of user communications and detect a trigger when the communication status has satisfied a predetermined condition. If the trigger is detected, mobile radio terminals 21, 22 acquire a reception status of a radio signal  
10 and the position of the mobile radio terminal. And, Mobile radio terminals 21, 22 send measured information including said reception status and said position. Information collecting server 1 receive the measured information from mobile radio terminal 21, 22 and record the measured information which has been received.

15 [Representative Drawing] Fig. 1